MicroCoating Technologies, Inc. – An Overview

MicroCoating Technologies, Inc. (MCT) is an innovative coatings and advanced materials company located in Atlanta, Georgia.

Dr. Andrew Hunt started MCT in 1994 after finishing his doctorate degree from the School of Materials Science and Engineering at the Georgia Institute of Technology. Dr. Hunt's work in thin-film vapor deposition techniques led to his breakthrough **Combustion Chemical Vapor Deposition[1] (CCVD)** process (U.S. Patent No. 5,652,021), whose initial concept was proven via independent experiments in his own backyard. CCVD is an innovative **open-atmosphere (non-vacuum), flame-based technique** for depositing high quality thin-films of advanced materials, such as metals, ceramics, plastics, or composites. Thin films formed by the CCVD process exhibit superior properties for a wide range of applications, including glass, fuel cells, superconductors, electronics, polymers, and corrosion resistant materials. When compared to traditional thin film deposition techniques -- sol-gel, chemical vapor deposition (CVD), and physical vapor deposition (PVD) -- the CCVD process offers compelling cost and environmental advantages, as well as greater flexibility and process control.

Started "on a shoestring" budget, the company has grown from essentially a one-person operation to a state-of-the-art research, development and production organization. MCT has over 70 employees, over half of which have advanced degrees in the physical and applied sciences, business administration, law, and other disciplines. MCT prides itself on the broad diversity, knowledge, backgrounds, and teamwork of its people[2].

MCT has experienced 100% annual revenue growth, while maintaining profitability since 1995. To accelerate the enormous potential of the company, management made the decision to team with Noro-Moseley Partners, the southeast's largest venture capital firm. With the resulting infusion of capital (coupled with the capabilities of MCT's employees and technology), MCT expects to attain its revenue growth objectives as we move towards an initial public offering.

MCT is organized around eight functional divisions and one wholly-owned subsidiary. These entities are supported by the Facilities and Equipment, FAST (Functional Analysis & Support Team) and COAT (Central Operations & Administration Team) organizations. The divisions are organized as profit centers, and target specific thin film market segments and industries.

The company's motto, **"Building the Future Layer by Layer"**, reflects a commitment to providing our clients and partners with coatings and other advanced materials technologies to address market needs. Through our **people, technology, strategic vision, and alliance partners**, MCT is focused on revolutionizing the marketplace for thin film and related technologies.

Contact Information: Heidi Carson Solomon – Ph (678) 287-2482 * Fax (678) 287-2499 sales@microcoating.com

[1]Georgia Tech Research Corporation exclusively licenses CCVD technology to MCT.

[2]MicroCoating Technologies, Inc. is an Equal Opportunity Employer.

Combustion Chemical Vapor Deposition: A New Approach for SOFC Materials

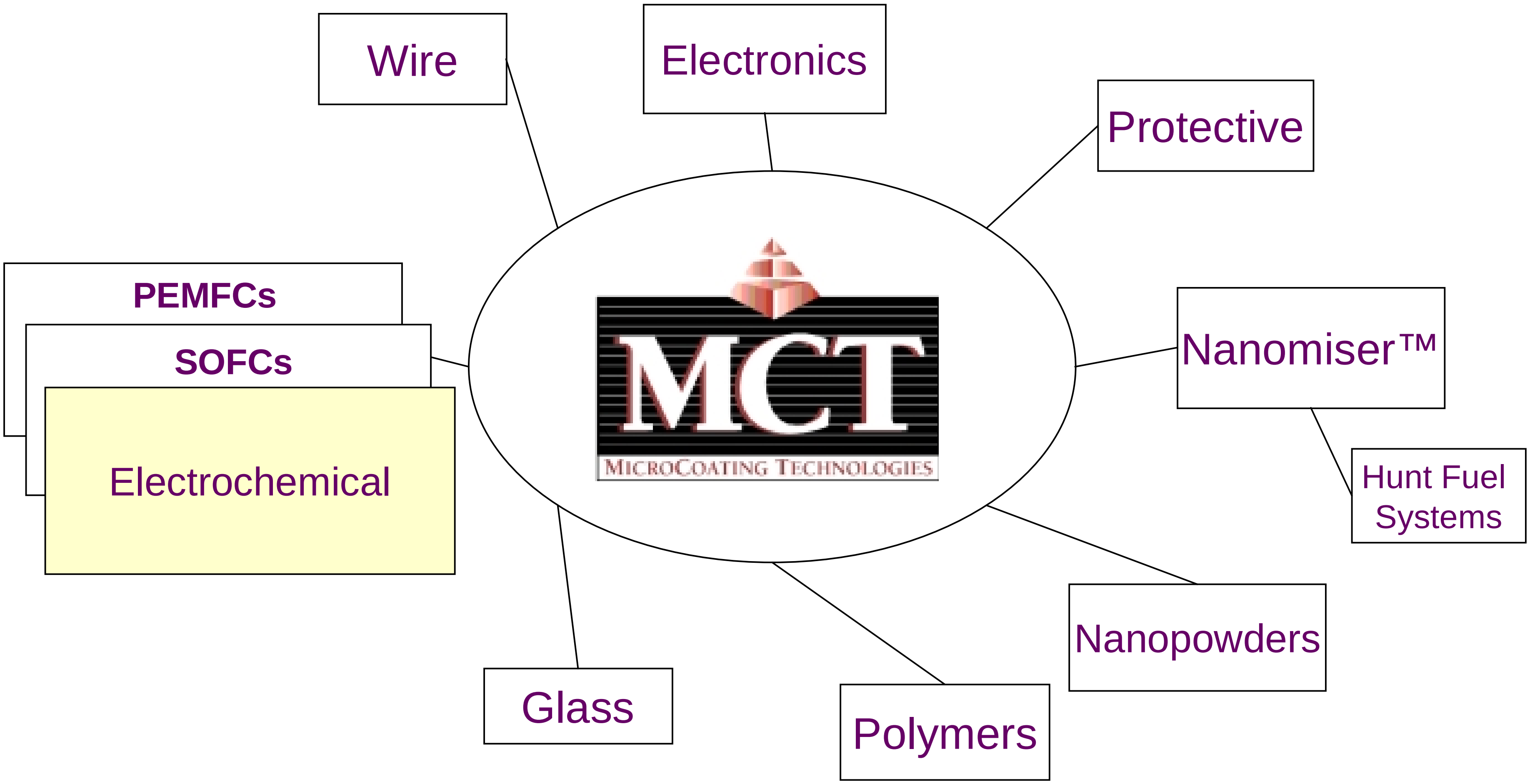
Program Director: Dr. Peter W. Faguy

MCT's Background

An Advanced Materials Company

- Founded in late 1993 to commercialize the CCVD process
- Expanded intellectual property (via patents)
- Housed in 20,000+ square foot facility
- Maintained profitability since 1995
- State-of-the-art research/prototype production facility

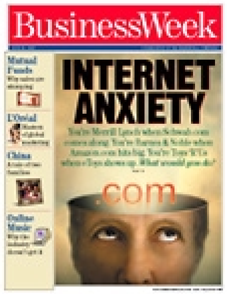
MCT's Corporate Structure



Recognition and Partners

MCT

IndustryWeek IW



SEE WHO'S ON CNN

U.S. Tech Interactive

Department of the Navy, United States of America

BMDO
Ballistic Missile Defense Organization
SBIR / STTR
The Small Business Innovation Research Program / Small Business Technology Transfer

National Institute of Standards and Technology
atp
Advanced Technology Program

United States Department of Energy
Science, Security and Energy: Powering the 21st Century

National Science Foundation
Celebrating 50 Years

BALLARD

AlliedSignal

SULZER

Lucent Technologies
Bell Labs Innovations

Southwire

LOCKHEED MARTIN

OHIO STATE

Rensselaer
why not change the world?

Georgia Institute of Technology

CCVD Technology

Flame assisted open atmosphere process

Base Materials include metals, ceramics, glass, and plastics

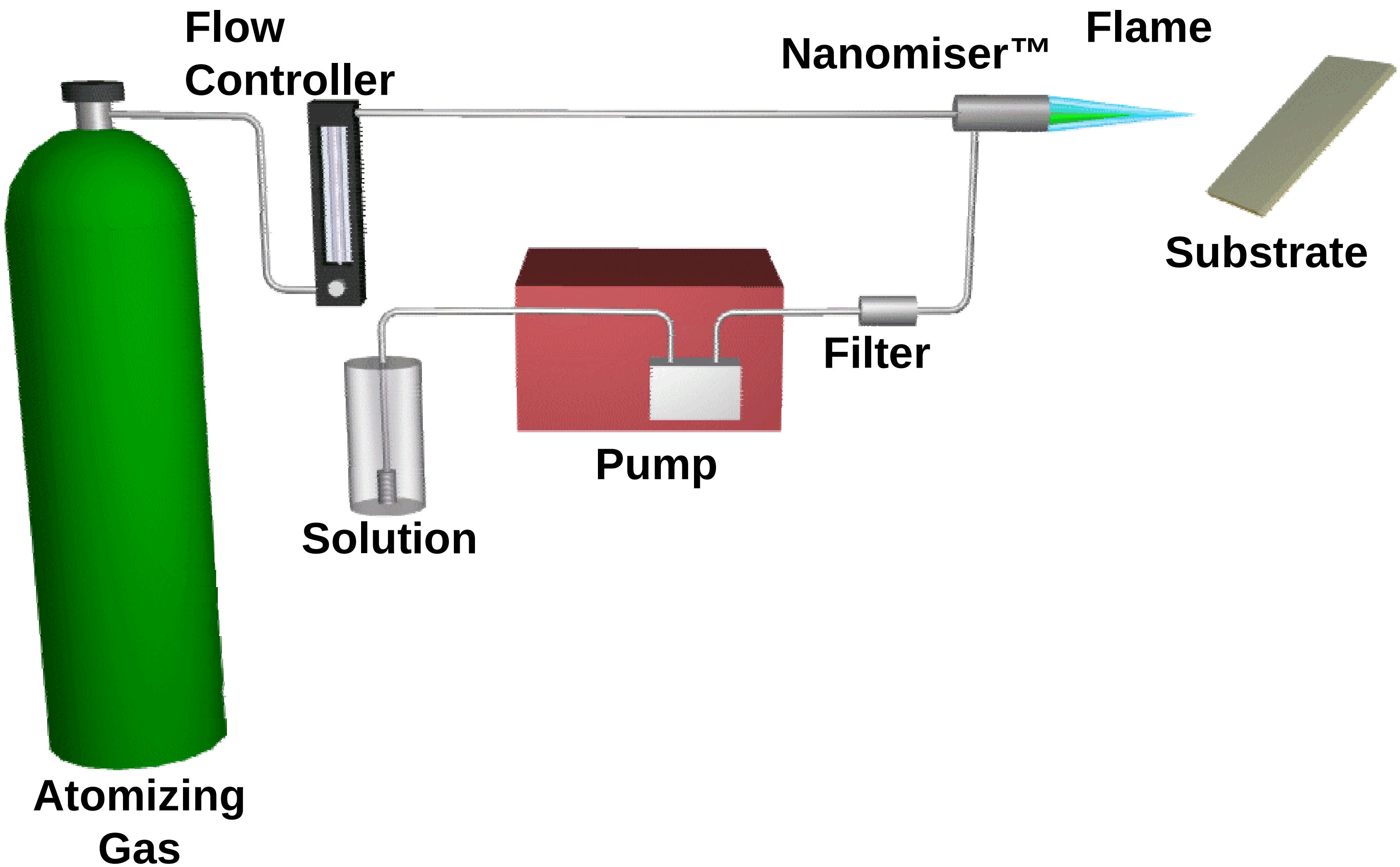
Deposited Materials include metals, ceramics, and composites

High quality thin films that are equal or better than traditional technology

CCVD process licensed from Georgia Tech Research Corporation

Georgia Institute of Technology

CCVD System


Flow
Controller
Nanomiser™
Flame
Substrate
Filter
Pump
Solution
Atomizing
Gas

CCVD Technical Top Ten List

MCT

- Deposits very thin films, 10 nm, to thick films > 5 µm.
- Controls density/porosity.
- Enables high compositional control and multi-layering.
- Deposits onto complex/large substrates
  not line of sight
- Allows substrate temperatures less than 100°C.
- Offers *in situ* capability.
- Forms epitaxial and preferred growth films
- Avoids use of high vapor pressure precursors.
- Enables up to 1 µm/min dense oxide coatings.
- Facilitates quick development cycles.

Examples of Deposited Materials

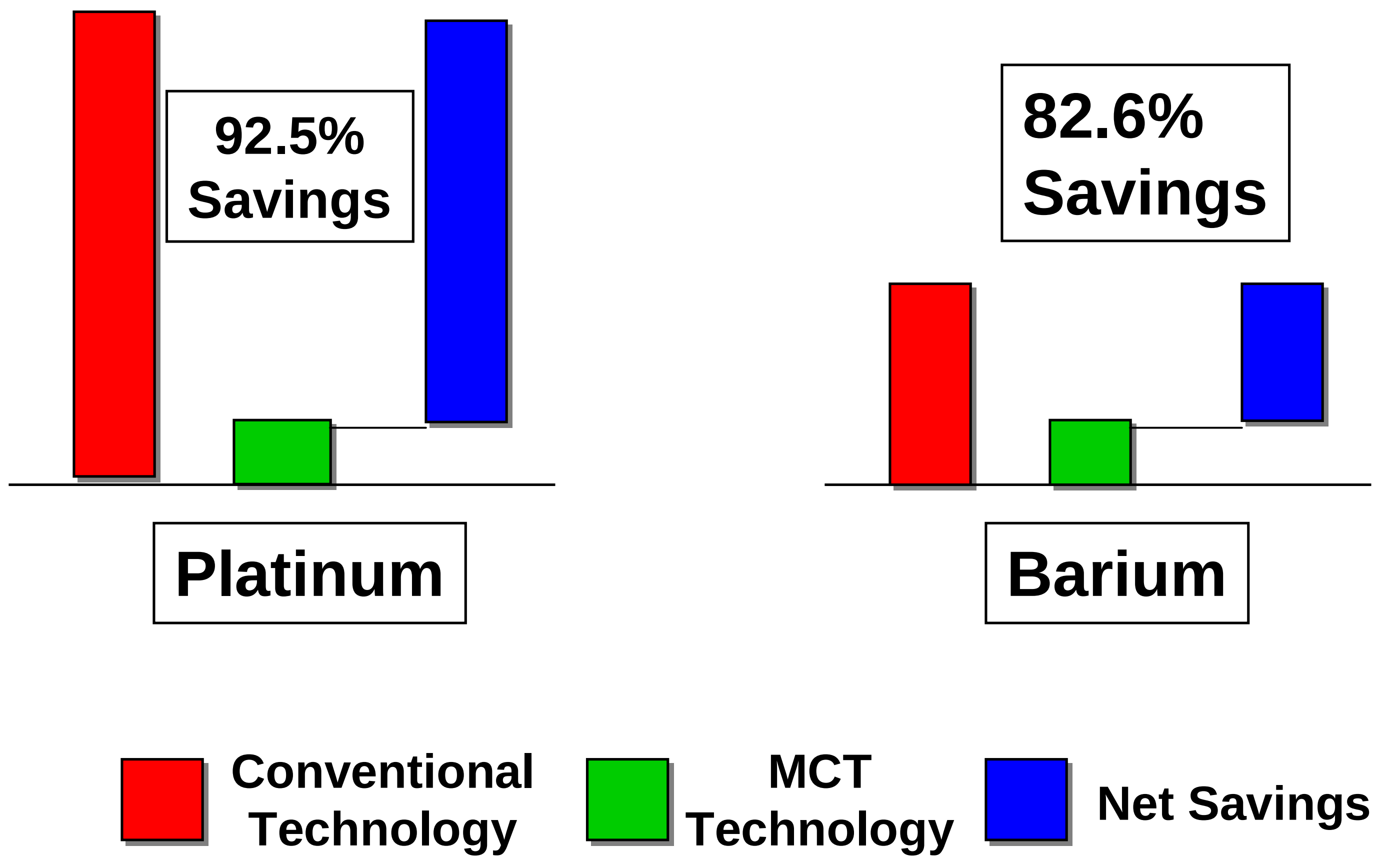
MCT

- **Metals**
  - Ag, Au, Cu, Ni, Pt, Ga and Rh
- **Ceramics**
  - Silica glasses
  - YSZ-Ni and ZrO_2
  - PZT
  - Complex oxides(perovskites etc.)
- **Other**
  - GaN, AlN, WC
  - $LaPO_4$, $BaCO_3$
  - $PbSO_4$
- **Over 70 Different Materials**

- **Substrates Used**
  - Al, Brass, Ag, Cu, Pt, Ni
  - Stainless and Carbon Steel
  - Al_2O_3
  - Fiber tows
  - Glass
  - Graphite
  - Nafion™
  - Polycarbonate
  - Silicon
  - Super Alloys
  - YSZ

Chemical Cost Savings

MCT



Capital Cost Savings

MCT

Traditional thin film technology equipment costs significantly more than CCVD equipment

Traditional Thin Film Equipment

CCVD Equipment

$500,000 - $20,000,000

$100,000 - $1,000,000

Competitive Comparison

MCT

	CVD	PVD	Sol-Gel	Plating	CCVD
Cost	-	O	O	+	+
Substrate	O	O	-	-	+
Flexibility	-	-	-	O	+
Environmental	O	+	+	- -	+

Government Developments

MCT

Corrosion and Thermal

- Chrome & paint replacement (Navy)
- Turbine engines (Navy & BMDO)

Electronics

- Electronic packaging (Navy)
- Metallization and dielectrics (4)
- Nitrides and carbides (BMDO)

Electrochemical

- PEMFC development (NSF)
- SOFC development (DOE)
- O_2 separation membranes (DOE)

Glass

- Solar cell superstrate (ATP)

Nanopowders

- Low cost complex oxide (BMDO)

Wire

- Superconductors (DOE & NREL)

Ion-Conducting Oxide Ceramic Materials for Solid Oxide Fuel Cells using Novel Low Cost Combustion Chemical Vapor Deposition Technique

MCT proposes to fabricate individual solid-oxide fuel cells by depositing high-quality, dense, pinhole-free thin layers of ionic-conducting oxide ceramic membrane electrolyte, and columnar electrode layers with unique crystal structures for SOFCs.

The Phase I results are expected to demonstrate that CCVD is a versatile technique capable of producing microstructures and crystallinity needed in electrolytes and electrodes for improving fuel cell performance. In addition, with its open-atmosphere capabilities, CCVD enables continuous depositions of complex oxides with at least a 50% reduction in capital cost and with a 75% reduction in operational costs compared with the other CVD processes.

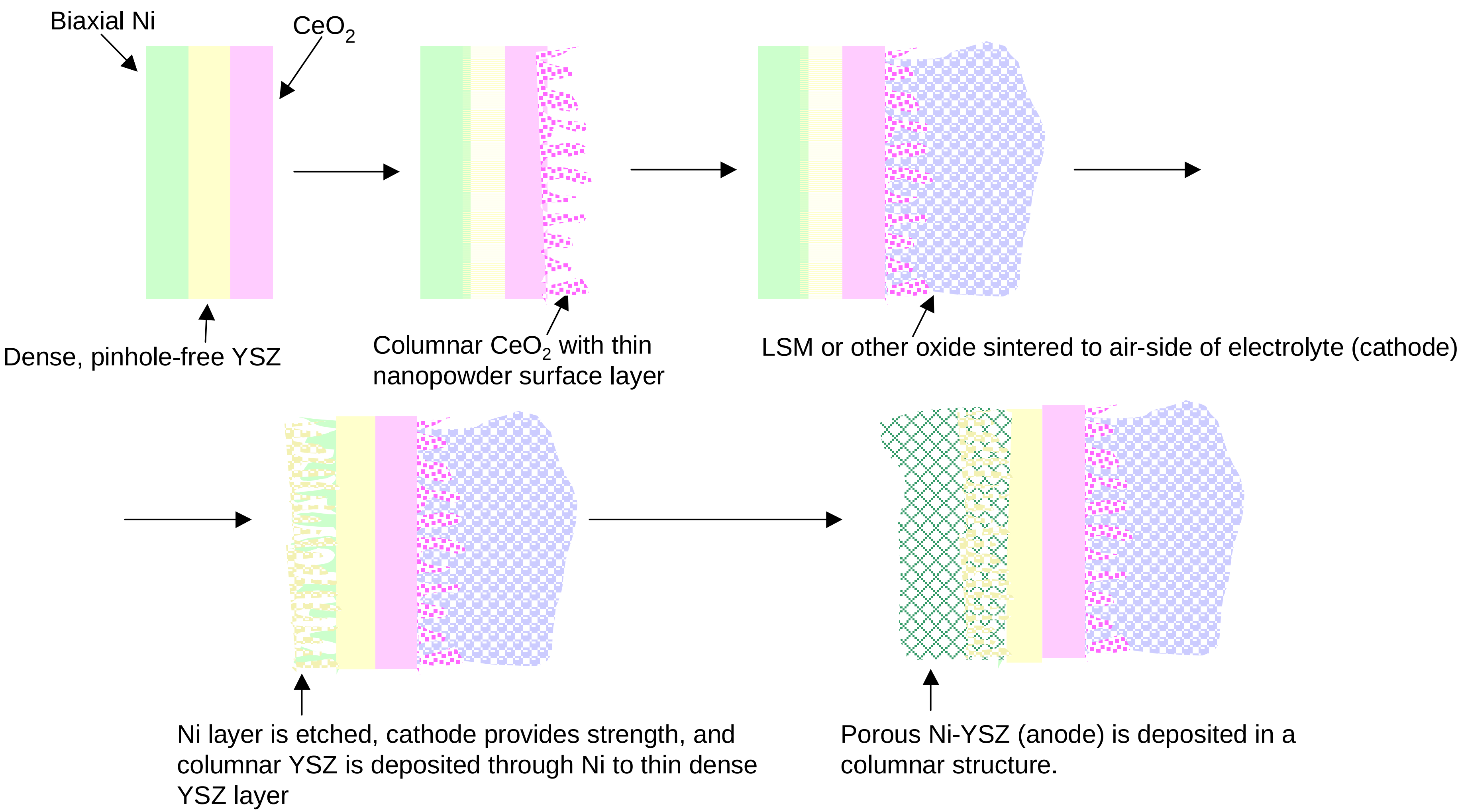
Mixed-Conducting Oxide Ceramic Membranes for Oxygen Separation using Novel Low Cost Combustion Chemical Vapor Deposition Technique

Hybrid, multilayer membranes with improved efficiencies and lifetimes will be developed. These membranes will combine the strengths of the individual component layers while eliminating the inherent weakness of the individual layer materials thus decreasing the cost of oxygen recovery from air.

Phase I will involve the development of a prototype system for production of composite membranes and the optimization of the specific solutions and deposition conditions for the preparation of the hybrid layers by CCVD. Coupon sized mixed-ionic conducting membrane samples will be prepared. These membranes will be tested for ionic conductivity using complex impedance analysis. A high-temperature gas permeation cell will be constructed to test membrane performance.

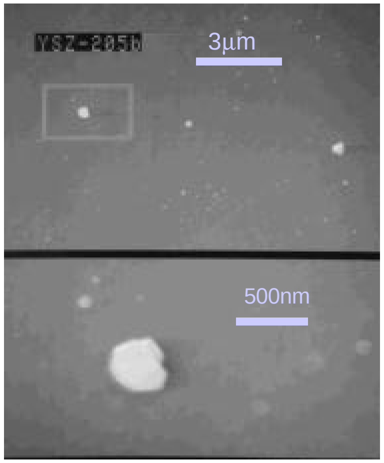
Proposed turn-key CCVD process to fabricate SOFCs

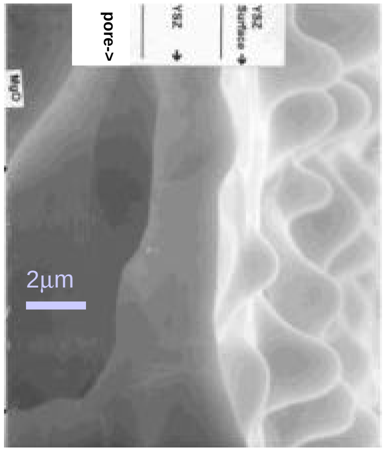
MCT



Range of YSZ thin films deposited by CCVD processing

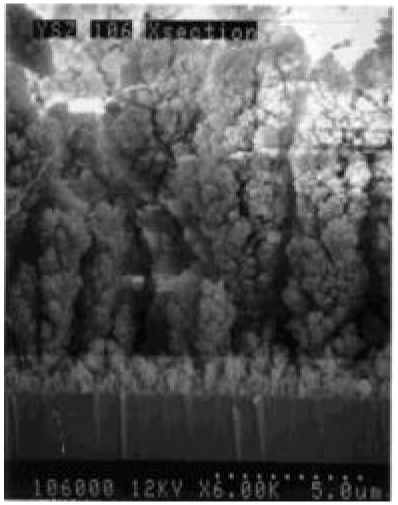
dense, no grain boundary (white particles are foreign particles used for contrast)

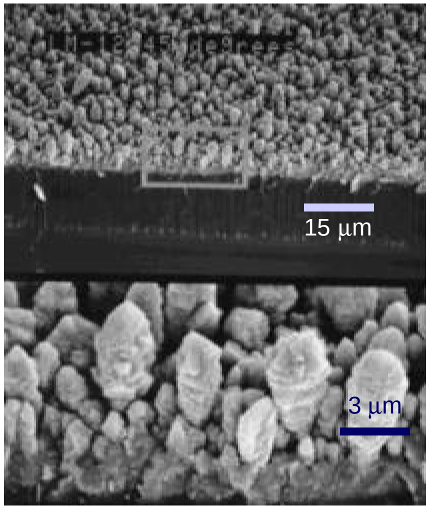




undulating structure to increase electrolyte surface area

columnar structure





LSM on sapphire showing a porous and a columnar microstructure.

CCVD Advantages Stack Up to...

MCT